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Western Reserve  
University

Cleveland Ohio

Instruction in the

Biological Sciences

For Graduates and Undergraduates



1899=1900

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For information regarding work in the Biological Sciences,  
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FRANCIS HOBART HERRICK, <i>Professor of Biology.</i>	7 Cutler St.
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## OFFICERS OF INSTRUCTION IN THE BIO- LOGICAL SCIENCES.

ADELBERT COLLEGE, THE COLLEGE FOR WOMEN,  
AND THE GRADUATE SCHOOL.

FRANCIS HOBART HERRICK, PH. D., D. Sc., <i>Professor of Biology.</i>
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CARL B. JAMES, B. S., <i>Assistant in Biological Laboratory.</i>

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WILLIAM T. HOWARD, JR., A. B., M. D., <i>Professor of Pathology, Pathological Anatomy and Bacteriology.</i>



## I. INTRODUCTION.

Biology is concerned with the present and past organic life of the world. It is therefore the history of living organisms, which embrace man, animals and plants, in the popular classification. The treatment of its subject matter, however diverse, may be summarized as morphology or anatomy in its broadest sense—the science of the structure of organisms, and physiology—the study of their functions. We might add also œcology, a subject closely allied to physiology—the study of the conditions of existence or the manifold relations of living things to each other, to climate, and the varied factors in their natural environment.

Numerous terms and phrases have arisen to designate certain subjects which the development of biological science has brought into prominence, some of which are of recent origin. Again branches of biology in the wider sense like human anatomy, embryology and physiology—of man and higher vertebrates—from their great importance to medicine, and early association with medical schools, have been treated as independent branches of science. The field of comparative anatomy—of vertebrates chiefly—was gradually extended after the invention and perfection of the microscope to embrace the finer structure of the individual at every stage of development throughout the entire series of living organisms. Finally the scope of physiology, for a long period too closely confined to men and higher animals, was extended to a closer scrutiny of the varied activities of cell life, to the formation of the embryo, the physiology of the lower organisms, and to the general relations of living things,—a field cultivated but little in the last century, extended in many

directions by Darwin, Pasteur, and Johannes Müller, and under various descriptive phrases is receiving the attention it has long deserved, with great promise for the future.

A logical classification of the sciences dealing with life is easily made, but is not commonly followed, owing partly to historical influences, and partly to individual habits and preference. The term "Biology" does not find favor with those who prefer the older "Zoology" and "Botany." It is customary to divide the natural sciences into biological (those which deal with organisms), and physical sciences (those concerned more particularly with the inorganic world). Biology has no exact counterpart in the physical group, but is thus compared with a series of sciences (astronomy, chemistry, geology, physics, etc.) This objection, however, is not valid, since the primary classification is one of convenience merely—all science dealing with any part of the physical world being physical science. The genius of language rides over logic and individual preference, and preserves such words as take root and are useful. Such a comprehensive term as Biology is useful in marking the distinction between living and dead matter, a barrier which appears even stronger to-day than in the time of Aristotle. It also points to a positive character of all living things—blood relationship—the expression of an idea which has no meaning in the inorganic world. A single term to express this fundamental relationship is again useful in emphasizing the fact that there is no sharp line of division between animals and plants in their lower orders, and in restricting that tendency to narrowness which is too often the price paid for special knowledge, when students of one branch of a great subject ignore all others springing from the same stock. On the other hand the term biology is objectionable



in so far as it carries the false impression, that it differs in subject matter from botany and zoology in their widest sense.

Elementary biology (Course I), is made as much as possible a course in general culture, and as introductory to more detailed studies. It is treated in its broader aspects as the study of animals and plants, and incidentally in its relations to human life, to psychology, sociology and philosophy. An elementary knowledge of physics and chemistry is desirable.

In preparation for the study of medicine, the elementary course (I) may be followed by course III—Vertebrate Morphology and course IV—Mammalian Anatomy; courses VI—Histology, and VII—Embryology, may take the place of similar work (in whole or part) in the Medical College, and if possible one or more of the following courses should be added: IX—General Physiology, II—Morphology of Invertebrates, and X—Botany.

For those who intend to become teachers, courses II, III, IV and X should be followed by such work as the student is able to elect upon the advice of the instructor. All students giving special attention to these subjects will be advised as to what work they should pursue.

Laboratories designed for the study of the biological sciences are for the most part the products of the last quarter century. The conventional treatment of both Zoology and Physiology has without doubt been far too narrow. While the anatomy and development of an animal or plant, and the principles of vertebrate physiology are taught, little is apt to be learned of the habits, instincts, intelligence, mode of life, relations to environment, variation,—subjects concerning which some of the most interesting scientific work of the

century has been accomplished. The establishment of marine laboratories has done much to remove this defect. Instructors should interest their students more in *living* organisms, and in those experimental studies which can be profitably carried on. It must, however, be understood that the serious consideration of general biological problems requires prolonged observation, well trained minds, and, for undergraduate students, forms no substitute for the elementary discipline of anatomy and physiology.

The laboratory now in the course of construction has been planned to emphasize as far as possible the study of *living* organisms, and to thus develop wider interest in the living world, so that a love of nature which is one of the finest results of a liberal culture may be strengthened and not overgrown during the years of college life.

## II. SYNOPSIS OF COURSES.

NOTE—All courses in biology are to be considered as three-hour courses, excepting V, XI and XII, and consist of two laboratory exercises weekly and one recitation or lecture. The hours of exercises are scheduled at the beginning of each term. Programmes of work carried on in the laboratory are furnished to each student.

Students who desire to work out of the usual hours, will be provided with the necessary materials whenever possible. The laboratory is open from 8:30 a. m. to 5:30 p. m., and under the direction of instructors during the hours scheduled.

I. ELEMENTARY BIOLOGY. Adelbert College,—Required second half sophomore year; College for Women—Course I belongs to a group of three courses—Biology I, Chemistry I, and Physics I, two of which are required of all students.

II. ZOOLOGY. Invertebrates.—(Required introductory course, Biology I); first half-year.

III. ZOOLOGY. Protochordates and vertebrates,—(Required introductory course, Biology I); second half-year.



IV. ZOOLOGY. Mammalian Anatomy.—(Required introductory courses, I and III); first half-year.

V. ZOOLOGY. Research in Animal Morphology.—For graduate students only. Throughout the year.

VI. HISTOLOGY. Vertebrates. — (Required introductory courses, Biology I, and III or IV); second half-year.

VII. VERTEBRATE EMBRYOLOGY. (Required introductory work, Biology I, and III or IV); second half-year.

VIII. ELEMENTARY PHYSIOLOGY. (Required introductory work, Biology I); open to students of College for Women only definite announcement to be made later in year.

IX. GENERAL PHYSIOLOGY. Experimental Biology. — For graduate students and seniors at discretion of instructor; first half-year.

X. BOTANY. (Required introductory work, Biology I, at discretion of instructor); second half-year.

XI. LECTURES IN ELEMENTARY BIOLOGY. Open to first year students in the Medical College November to March.

XII. READING CLUB. Open to students in courses II-X at Adelbert College, the College for Women and Graduate School, throughout the year.

### III. DESCRIPTION OF COURSES.

I. ELEMENTARY BIOLOGY. An introduction to the study of organisms from the basis of morphology, physiology and development. In this course the elementary facts and principles of Biology are taught, as a means of general culture. It also furnishes the basis for more detailed studies in Zoology, Botany, Anatomy, Physiology and Medicine. Unicellular plants and animal tissue cells and representatives of higher animal and vegetable life contribute the materials for this work.

Printed laboratory directions have been prepared and the following works of reference are recommended: *Atkinson*, Elementary Botany; *Goebel*, Outlines of Classification and Special Morphology of Plants; *Hertwig and Field*, General Principles of Zoology; *Huxley*,



*Martin et al.*, A Course of Elementary Instruction in Practical Biology; *Morgan*, Animal Life and Intelligence; *Parker*, Elementary Biology; *Sedgwick and Wilson*, An Introduction to General Biology. Second half-year.

II. ZOOLOGY. Animal Morphology (Invertebrates).—Laboratory instruction will embrace the study of the anatomy and in some cases the development of certain types of invertebrate animals such as the following: sycon and leucon sponges; alcyonarian and hexactinian corals; tubularian and campanularian hydromedusae; asteroid, echinoid and holothuroid echinoderms; planarian and cestode worms; polychætous and oligochætous annelids (*Nereis* and *Lumbricus*); parasitic copepod; phyllopod, copepod, cirriped, amphipod, and decapod crustacea; *Limulus*; arachnid; orthopterous, lepidopterous or coleopterous insect; lamellibranchiate, gasteropodous and cephalopodous molluscs.

The following works of reference may be consulted:—*Boas*, Lehrbuch der Zoologie; *Brooks*, Handbook of Invertebrate Zoology; *Bumpus*, A Laboratory Course in Invertebrate Zoology; *Claus et al.*, Elementary Text Book of Zoology; *Lancaster*, Zoological Articles from Encyclopædia Britannica; *Lang et al.*, Text Book of Comparative Anatomy, Pt. I; *Marshall and Hurst*, A Junior Course of Practical Zoology; *McMurrich*, A Text Book of Invertebrate Morphology; *Parker and Haswell*, A Text Book of Zoology, Vol. I; *Thompson*, Outlines of Zoology. First half-year.

III. ZOOLOGY. Animal Morphology, (Protochordates and Vertebrates.)—A detailed study through dissection of the general anatomy of an ascidian, *Balanoglossus*, *Amphioxus*, cyclostome, teleost, amphibian, bird, and reptile.—Continuation of course II and introductory to course IV.

The following works are recommended for reference: *Dean*, Fishes Living and Fossil; *Ecker and Haslam*, The Anatomy of the Frog; *Huxley*, A Manual of the Anatomy of Vertebrated Animals; *Marshall*, The Frog; *Parker*, A Course of Instruction in Zootomy (Vertebrata); *Parker and Bettany*, The Morphology of the Skull; *Parker and Haswell*, A Text Book of Zoology, Vol. II; *Lankester*, Zoological Articles from Encyclopædia Britannica; *Reynolds*, The Vertebrate Skeleton; *Wiedersheim and Parker*, Elements of the

Comparative Anatomy of Vertebrates or *Wiedersheim*, Lehrbuch der Vergleichenden Anatomie der Wirbelthiere; *Wiley*, Amphioxus and the Ancestry of the Vertebrates. Second half-year.

IV. MAMMALIAN ANATOMY. Macroscopic Anatomy of the Mammalia.—A general survey of the structure and classification of the higher vertebrates is followed by the comparative study of the mammalian skeleton and dissection of important organs. Attention is directed to the geographical distribution of the mammalia, to their environment, and relations to the lower vertebrates. Physiological demonstrations are given in dealing with the muscles and sense organs. Each student is required to make notes and drawings of some special dissection assigned during the course.

The following works may be consulted: *Flower*, An Introduction to the Osteology of the Mammalia; *Gray*, Anatomy, Descriptive and Surgical; *Gorham and Tower*, A Laboratory Guide for the Dissection of the Cat; *Howell*, Dissection of the Dog; *Huxley*, A Manual of the Vertebrated Animals; *Jayne*, Mammalian Anatomy, Pt. I, The Skeleton of the Cat; *Krause*, Die Anatomie des Kaninchens; *Marshall and Hurst*, A Junior Course of Practical Zoology, Chap. XII, The Rabbit; *Parker*, A Course of Instruction in Zootomy (Vertebrata); *Parker and Bettany*, The Morphology of the Skull; *Parker and Haswell*, A Text Book of Zoology, Vol. II; *Quain et al.*, Quain's Elements of Anatomy, Vol. II, Pts. I, II; *Reynolds*, The Vertebrate Skeleton, Chaps. I, II, XX; *Thompson*, Outlines of Zoology, Chap. XXX, Mammalia; *Wiedersheim and Parker*, Elements of the Comparative Anatomy of Vertebrates. First half-year.

V. ZOOLOGY. Research in Animal Morphology.—The assignment of special problems for investigation, with individual instruction and supervision. For graduate students only. Laboratory work throughout the year.

VI. HISTOLOGY. Microscopic Anatomy—Chiefly Vertebrates.—An elementary course in the analysis of the tissues of the body of man and higher vertebrates. Special attention is given to technical methods in histology, such as the preparation, staining and sectioning of animal tissues. Students are required to prepare only such material as will give them an available knowledge of the best methods in present use.



Works of reference are: *Schäfer*, The Essentials of Histology; *Wilson*, The Cell in Development and Inheritance; *Lee*, Microtometist's Vade-Mecum; *Piersol*, Text Book of Normal Histology. Second half-year.

VII. VERTEBRATE EMBRYOLOGY—Chiefly of the Chick.—A detailed study of the development of the bird, and the general principles of the embryology of vertebrates. The student in this course must prepare the material which he uses, both entire embryos and sections, representing certain well defined stages in the development of the fowl.

The principal reference books are: *Foster and Balfour*, The Elements of Embryology; *Marshall*, Vertebrate Embryology; *Hertwig and Mark*, Text Book of the Embryology of Man and Mammals; *Minot*, Human Embryology; *Wilson and Leaming*, An Atlas of the Fertilization and Karyokinesis of the Ovum; *Wilson*, The Cell in Development and Inheritance. Second half-year.

VIII. ELEMENTARY PHYSIOLOGY. The general principles of the physiology of higher and lower vertebrates. To be open to students at the College for Women. Definite announcement to be made later.

IX. GENERAL PHYSIOLOGY or Experimental Biology.—The action of physical forces and chemical reagents upon living protoplasm as displayed in the simpler organisms, the phenomena of growth, cell-division and cell differentiation, are the subjects dealt with in this course, the object being to present the results of recent studies and to direct the performance of certain well defined experiments.

Works of reference are: *Davenport*, Experimental Morphology; *Morgan*, The Development of the Frog's Egg; *Verworm*, Allgemeine Physiologie; and numerous special papers.

Open to graduate students and to Seniors at the discretion of the Instructor; first half-year; laboratory hours arranged for individual students.

NOTE.—For instruction in Human Anatomy, Physiology, Bacteriology and Pathology, students at Adelbert College should consult description of courses in the Medical College of this University. Seniors in Adelbert College may elect work in the Medical College, giving a credit of six hours a week in the requirements for the academic degree. It thus becomes possible for such students to complete one of the four years required for the degree of Doctor in Medicine during their academic course.

X. BOTANY. An introduction to the study of plants on the basis of their physiology, morphology and general relations.

Works of reference are: *Atkinson*, Elementary Botany; *Bessey*, Botany; *Britton and Brown*, Illustrated Flora of North America; *Darwin*, Insectivorous Plants, The Power of Movement in Plants, and Cross and Self-Fertilization in the Vegetable Kingdom; *DeBary*, Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria; *Goebel*, Outlines of Classification and Special Morphology of Plants; *Kerner and Oliver*, Natural History of Plants; *Müller*, The Fertilization of Flowers; *Strasburger, et al.*, A Text Book of Botany; *Vines*, Student's Text Book of Botany. Second half-year, with field excursions.

XI. LECTURES ON ELEMENTARY BIOLOGY. A series of twenty lectures on the elementary principles of biology dealing with the general physiology, morphology and relations of organisms. Given to first year students in the Medical College, Monday afternoon, Nov. to April, 1898-1899.

Reference works: *Hertwig and Field*, General Principles of Zoology, Henry Holt & Co.; *Parker*, Elementary Biology, The Macmillan Co.; *Wilson and Sedgwick*, An Introduction to General Biology, Henry Holt & Co.

XII. READING CLUB. A voluntary association of students and instructors for reading and discussing works of general scientific interest. As at present arranged, meetings are held weekly on Saturdays, 11:30 A. M., alternately at Clark Hall and the main building of Adelbert College.

The following works, appended for convenience of reference, deal chiefly with plants, animals and man in their broad relations to each other and to the world. From these and similar works selections will be made. *Bates*, The Naturalist on the River Amazons; Challenger Reports—Narrative of the Voyage, Vol. I, Pt. I; *Cope*, The Primary Factors of Organic Evolution; *Darwin*, Life and Letters of Charles Darwin, Journal of Researches During the Voyage of the Beagle Around the World, The Origin of Species by Means of Natural Selection or the preservation of Favored Races in the Struggle for Life, The Descent of Man and Selection in Relation to Sex; *Hudson*, The Naturalist in the Pampas; *Huxley*, Essays; *Marcou*, Life and Letters of Louis Agassiz; *Marshall*, Lectures on



the Darwinian Theory, Biological Lectures; *Morgan*, Animal Life and Intelligence; *Osborn*, From the Greeks to Darwin; *Poulton*, Darwin and Natural Selection; *Romanes*, The Scientific Evidences of Organic Evolution, Darwin and After Darwin, Animal Intelligence; *Wallace*, Darwinism; *Weismann*, Essays.

A FIELD CLUB was organized at the College for Women in April, 1898, for the purpose of studying the flora and fauna of this region, and it is hoped to extend its work in the future.

#### IV. LABORATORIES.

A new building specially designed for the study of the biological sciences was begun in October, 1897, and is now approaching completion. When suitably equipped this laboratory will afford ample opportunities for the instruction of large classes; and for individual study and research.

The building is a substantial stone structure in Gothic design, of three stories with a closed basement for hot air ducts and pipes. It stands on the campus of Adelbert College, south of the physical laboratory, and faces west, with ample space on all sides. The outside dimensions are 93 feet by 63 feet. Small wings project from the north and south ends and extend up to the second story. No pains have been spared to provide the best available means of lighting, heating and ventilation. Gas for combustion purposes, water, and electricity for artificial light, are conducted to all working rooms. Heat and ventilation are provided by currents of air heated by steam from a central station in the main building, and driven by a steam fan. In those rooms where the nature of the work makes it necessary to avoid strong air currents, direct steam radiation will be used.

The first story contains suitable rooms for anatomy, botany, aquaria, combustion of refuse and the heating ap-

paratus, also a workshop, store, coat and toilet rooms, and a janitor's room. The engine and fan are placed in the north wing to avoid noise and vibration in the main structure. A solid partition divides the south wing which contains on one side a small conservatory for plants, on the other smaller rooms with entrance from the outside. A large water tank is set in the floor of the conservatory, in which aquatic animals and plants can be reared. This section is so planned so that as soon as it is possible to establish a department of Botany, a greenhouse extension of any desired proportions can be easily added. Several rooms of the first story have cement floors, a number of which have been designed for vivaria. In these living animals can be reared and studied.

The main elementary laboratory, 60 feet by 27 feet, in the second story faces north, and is lighted by eighteen windows of ample size. It is designed for the conduct of elementary classes in morphology and physiology. An adjoining room connects by lift with combustion room below. In the same story are the offices of instructors, special library, special laboratory rooms for zoology and embryology, coat, cloak and toilet rooms, and preparation and supply rooms to the main laboratories.

The third story is divided into a large lecture room, a photographic laboratory, a series of museums and preparation rooms.

The lecture room has sufficient space to seat over two hundred persons. It is lighted mainly from above, and can be darkened instantaneously by automatic shutters. Provision will be made for the illustration of lectures by the projection both of photographic lantern slides and of microscopical objects, so far as such material can be used to advantage at the present time.



The photographic laboratory will be equipped as soon as possible with the necessary apparatus for the production of accurate pictures illustrative of the natural history of living things. The instructors are convinced that this will prove one of the most valuable adjuncts to the means of instruction and individual study.

The northern section of the building has a peaked roof, and a flat crenallated roof covers the southern end. The museum of the third floor is lighted by sky-light, and the hall below this partly by glass set in the flooring above, in accordance with the plan of placing here the popular collections of natural history.

*Laboratories of the Medical College.* Well equipped laboratories for the study of Human Anatomy, Histology and Dissection, Physiology, and Bacteriology are open to Seniors of Adelbert College under the conditions stated above.

## V. MUSEUM.

The museum rooms of the biological laboratory have been arranged with reference to a plan developed and outlined eight years ago, an account of which was given at a meeting of the Senate of this University, and afterwards printed. This plan of founding a teaching collection to illustrate the structure and development of types of organic life, including man, as well as special subjects of great general interest such as variation, protective coloration, and mimicry, homologies and progressive modification, has been kept in mind, and the material already obtained will be utilized as soon as the necessary means are assured for this purpose.



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The popular collections of natural history including the Winslow Collection of birds, the collection of the Kirtland Society of Natural History, of which Adelbert College is the custodian, will be placed according to the plan outlined above, in the halls of the laboratory, which have been specially adapted for this purpose. These attractive collections will thus be repeatedly passed by persons who enter the building.

## VI. LIBRARY.

All works pertaining to the biological sciences are kept in a special library in the biological laboratory, and are easily accessible at all times. This collection though small, and greatly in need of extension, contains the standard textbooks, a large number of special papers, monographs, valuable sets of periodical journals, and reports.

## VII. OTHER COLLECTIONS AND APPARATUS.

The laboratory possesses a small reference collection in botany, normal histology and embryology, and the usual optical and chemical apparatus for conducting elementary work in the biological sciences, and for the prosecution of independent investigation in zoology. The present equipment will be extended as far as possible and rendered more effective when the new building is completed.